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FRACTURES OF THE SPINE*

BY

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The years which have elapsed since the termination of the war have witnessed a remarkable increase in the interest taken by general surgeons in all kinds of injuries. The causes accounting for this change are manifold: (1) The modern surgeon who worked through the war years thereby gained a wide experience of traumatic surgery in general. (2) In all our voluntary hospitals to-day more beds than formerly are devoted to casualties, to the exclusion of less urgent cases such as hernia, enlarged lymph glands, chronic abscess, etc. (3) Many diseases formerly requiring admission to surgical wards are now treated medically or in the out-patient departments—for example, ulcer of the stomach and duodenum, varicose veins, haemorrhoids. (4) The toll of the road, which has followed the rapid growth in motor traffic, contributes to the out-patient departments, both by day and by night, patients in such serious plight that they cannot be denied admission to vacant beds. In my own wards, estimated over a period of a full year, we have found that 10 per cent. of the available bed space is occupied by persons injured in motor accidents.

Modern Methods in Diagnosis and Treatment

Spinal injuries in general and spinal fractures in particular contribute largely to the admission list of all surgical wards to-day. To the operating surgeon with experience of war wounds these are always interesting; to the house-surgeon in charge of the casualty department they are at once serious and urgent. But there are at least two other factors responsible for the almost universal interest which the general surgeon takes in spinal fractures. In the first place, the perfection in modern radiological technique has made it possible to demonstrate with the utmost precision the minute details of all such fractures in whatsoever area of the spine they occur. This has been attained by the routine use of lateral as well as antero-posterior films, by the influence of posture in the taking of films in certain situations, and by the more general use of the stereoscope. Secondly, and in great part owing to this improvement in radiology, the surgeon is enabled to apply with greater ease and exactitude treatment which, as time goes on, becomes more rational, more practical, and more efficient.

The crush fracture of the spine is no longer an obscure and difficult problem. It accounts for about 40 per cent. of all spinal fractures. In 70 per cent. of cases it is uncomplicated by injury to the spinal cord or nerve roots.

Its diagnosis is rarely in doubt, and treatment follows well-established lines. Such treatment demands the restoration of the spinal column to its normal alignment by means of hyperextension. But hyperextension for this purpose is not a recent discovery. For many years it was employed by Robert Jones, and in 1929 Davis advocated its combination with traction. Its present method of application, however, was a real discovery when it was first suggested by Watson Jones in 1930, and this, added to the improvements in radiology, has revolutionized the management of all cases of spinal fracture.

The popularity of the method depends on its ease and simplicity. Watson Jones's contributions to the literature of spinal fracture have clearly proved that owing to his technique, the prognosis, as regards both life and capacity for work, has become much more favourable during the last five years. As a result of his methods the profession and the public have learned that broken necks and broken backs are neither so disabling nor so deadly as they were formerly thought to be. We know, of course, that severe cord injury, even to the extent of complete division, does occur in some fractures of the spine, and that for this condition, when found, no radically curative method of treatment has yet been devised. It is also known that injury to nerve roots may be followed by serious incapacity for work owing to pain and paralysis, while severe injury to ligaments and muscles may entail weakness in the affected part. On the other hand, it is now widely recognized that injury confined to the compression of a vertebral body, where suitable treatment is applied, produces disability of a temporary nature only. Alternatively, where a similar fracture passes unrecognized, and therefore untreated, a disabling condition of wedge-shaped vertebra follows. This deformity, first described in 1895 by Kümmell as spondylitis traumatica, is now regarded as the result of an unreduced compression fracture of a spinal body.

Scope of Present Paper

This paper is based on my experience, including a review of thirty-four cases of fracture of the spine which were admitted to the various wards of the Royal Victoria Hospital, Belfast, during the years 1931-4. The investigation of these cases has been carried out by my present house-surgeon, Dr. A. F. Turner, to whom my best thanks are due. Four of the patients in this series died in hospital, and one died from cancer of the stomach two and a half years after leaving hospital. This series is a very short one, but it possesses at least one compensa-

* Read in opening a discussion in the Section of Orthopaedics at the Annual Meeting of the British Medical Association, Melbourne, 1935.

tion. Every one of the remaining twenty-nine cases has been seen and examined by Dr. Turner, who vouches for the results recorded.

Broadly speaking, the subject of spinal injuries is three-fold: first, fractures; second, dislocations; and third, injuries to soft tissues, including spinal cord, nerve roots, ligaments, and muscles. These may be combined in varying proportions, but owing to limitations of space and time I have found it necessary to confine my remarks to the first of these groups, excluding wholly injuries to soft tissues and dislocations, unless where the latter form obvious and inseparable complications of fracture.

Causation of Spinal Fractures

All the three causes of fractures in general are found operative in fractures of the spine: direct violence, indirect violence, and muscular violence. The preponderating cause, however, is that of indirect violence. Fracture of the spine is most often produced by falls on the head, buttocks, or feet, or, what amounts to the same thing, by the fall of a heavy weight, such as a sack of grain, upon the head or shoulders. In such cases acute flexion of the trunk is produced at the point where bony support is lacking—that is, where the thorax above and the pelvis and lower limbs below meet in the dorso-lumbar region. Less frequently the fracture may occur in the cervical region. This mechanism causes a crush or compression of one or two of the vertebral bodies. A continuation of the force may produce in addition a fracture or dislocation of the adjacent articular processes on one or both sides of the crushed vertebra, and is followed as a rule by the upper vertebra slipping forwards on the lower. Where a similar accident occurs with the spine held rigid the brunt of the force may be spent upon the atlas, and a fracture of this bone may occur.

Direct violence is responsible for fractures of spinous processes or laminae, and may result in part of a neural arch being displaced forwards into the cord. Theoretically, fractures of transverse processes may also be due to direct violence, but Davis has adduced strong arguments for assuming that these are more often broken as the result of muscular contraction.

Influence of Site

Classification of sites of thirty-four fractures of the spine:

Cervical region ...	...	...	...	...	3
Upper and mid-dorsal ...	...	...	...	...	2
Lower dorsal:					
D XI ...	...	...	...	...	2
D XI and D XII ...	...	...	...	...	1
D XII ...	...	...	...	...	7
					— 10
Lumbar region:					
L I ...	...	...	...	...	8
T.V.P. ...	...	...	...	...	8
Spine ...	...	...	...	...	1
					— 17
Coccyx ...	...	...	...	...	2
					— 34

It is relatively rare to find fractures in the upper dorsal region owing to the strong support afforded to this region by the ribs. A recent case of mine (not in the hospital series) may be cited. The patient was competing in a motor cycle race. His machine, after striking a bank, carried him over the opposite fence. Immediately after the accident his lower limbs were found to be completely paralysed. A fracture-dislocation of the fifth/sixth dorsal vertebrae was demonstrated by the radiologist. The patient was treated first by hyperextension, and later by

laminectomy, but still remains paralysed one year after the accident.

Fractures in the cervical region requiring treatment involve the area corresponding to the fifth cervical vertebra. In this region the fracture is often combined with a dislocation. Fractures in the cervical region, below the atlas and above the fourth, are usually accompanied by severe injury to the cord, and have not received much attention for the simple and sufficient reason that the patient is usually dead on arrival at hospital. On the other hand, in fractures of the atlas the patient often survives, for the cord escapes severe injury. A fracture of the odontoid process of the axis may be produced at the same time.

Crush fractures occur in most typical form in the dorso-lumbar region following the mechanism already described. Transverse processes are usually broken in the lumbar region. As a rule they are unilateral and multiple. They are produced by a violent contraction of the quadratus lumborum muscle. For legal reasons it is important to remember that congenital deformity may account for a breach in the continuity of a single transverse process in this region of the spine. Fractures of spinous processes or neural arches are due to direct violence, and they may occur in any region.

For descriptive purposes fractures of the spine may be classified as follows:

1. Fracture of the atlas. } These may occur singly or in
2. Fracture of the axis. } combination.
3. Fracture-dislocation in the cervical region.
4. Compression fracture.
5. Fracture of coccyx.
6. Fracture of spinous process, neural arch, or transverse process.

Fracture of the Atlas

Our knowledge of fractures of the atlas has been epitomized and perfected by Jefferson's classical article in the *British Journal of Surgery* (1919-20, vii). Jefferson has pointed out that this is a tension fracture, and arises from a spreading outwards of the ring formed by the atlas. A weight falling on the vertex transmits the force through the occipital condyles to the lateral masses of the atlas. The thickest part of the lateral mass is placed laterally. Both its superior and inferior articular facets therefore look to some extent medially. Hence a force applied through the skull tends to spread the lateral masses of the atlas outwards from the middle line of the body. This results in their divarication, and the posterior arch, which is weaker than the anterior, is broken. Less often the fracture may involve both arches, or the lateral mass itself may be broken. This fracture is not fatal in 45 per cent. of cases owing to the fact that the cord escapes gross injury. Fracture of the atlas may be associated with fracture of the odontoid process of the axis, more especially in cases where the downward pressure on the head is combined with hyperextension of the neck.

Diagnosis of fracture of the atlas depends on the history of a compression of the head upon the trunk followed by pain, inability to nod the head, to rotate it or even to support it without pain, rigidity in the muscles of the neck, and neuralgia or anaesthesia referred to the distribution of the great occipital nerve. On examination there may be undue prominence of the spine of the axis behind, and an abnormal prominence of one side of the atlas in the pharynx. It may be pointed out that normally the anterior arch of the atlas projects symmetrically into the pharynx and is easily palpable through the mouth. Confirmation of the diagnosis of this fracture must be sought in all cases by the help of radiology. When it is suspected, stereoscopic x-ray films, both antero-

posterior and lateral, should be obtained, especially the former, taken through the open mouth.

Treatment in the absence of deformity entails a prolonged period of immobilization in plaster-of-Paris, followed by the wearing of a leather collar. Where obvious deformity occurs it will usually require reduction. In this reduction there is always a danger of the surgeon's manipulation causing sudden death by the shift of a fractured odontoid process into the cord. Hence the necessity in all such cases for a clear demonstration of the condition of this process.

Fracture of the Axis

The commonest site of fracture in the axis is the base of the odontoid process. It is produced by pressure of the head upon the rigid spine, the neck being strongly hyperextended. It may be found associated with a fracture of the atlas. It is diagnosed by radiology in the same way as a fracture of the atlas, and treatment depends upon the same principles. Union of this fracture by bone is rare, the best that can be hoped for being a short fibrous bond.

Fractures in the Cervical Region

Fractures and fracture-dislocations in the cervical region below the axis may be subdivided anatomically into two groups: those above the fourth segment and those below this level. Injury above the fourth segment *without* cord lesion is usually a pure dislocation, though not seldom it is associated with lesions of nerve roots. It is characterized by deformity of the spine, and the diagnosis is readily confirmed by modern radiological methods. Reduction should be undertaken and the neck immobilized in plaster-of-Paris. But for the presence of pain, weakness, and stiffness in the affected region the prognosis is usually good. On the other hand, injuries with severe cord lesions are usually fracture-dislocations, and the patients die rapidly as the result of respiratory failure. They are for this reason of little clinical interest, since they rarely reach hospital before death has occurred.

In cases of cervical injuries below the fourth segment with severe cord lesions, even to the extent of complete division of the cord, the patient may continue to live owing to the escape of the roots of the phrenic nerve, which maintains diaphragmatic respiration. In all such cases, however, the ultimate prognosis is bad: permanent and complete paralysis below the affected level, followed by retention of urine, pyelitis, bed sores, and severe sepsis, being inevitable.

Three distinct types, depending on the situation of the lesion, are described and, as a rule, are easily distinguishable: (1) Injury above the fifth segment is characterized by complete paralysis of the arms. (2) Injury between the fifth and sixth segments permits shrugging of the shoulders, abduction of the shoulder-joints, flexion, and supination of the forearms; such patients automatically assume what is known as the "kamerad" position. (3) Injury below the level of the sixth segment permits of movements of the arms, though partial paralysis of the hands may be found. Partial paralysis of one or both arms in such cases may mean serious injury to the cord, injury to nerve roots, or injury to the brachial plexus.

Diagnosis of fractures in the lower cervical region depends on a history of an injury affecting this region followed by the development of pain, rigidity, and deformity; localization follows a neurological examination and identification of the nerve lesions, mainly pain, loss of sensation, and paralysis. Radiology will confirm

the signs and finally determine the exact site of the injury.

The main problem of treatment is whether reduction of any existing deformity should be attempted. Usually this will be carried out, and the effect of such reduction on ultimate recovery will depend on the exact nervous lesion. Cotton's summary of these cases is as follows:

1. The diagnosis of an injury to the spine in the lower cervical region is relatively easy.
2. Rotatory luxation is relievable by manipulation.
3. Where there is no displacement, with or without cord lesion, the patient should be left alone, except for provision of suitable support for the spine.
4. In fracture-dislocations with apparently irreparable cord lesions the prognosis is usually hopeless. A tragic case of this sort occurred in my experience. The patient, aged 25, an athletic young man with a golf handicap of + 4, struck the bottom on diving into the sea. He came to the surface face downwards, completely paralysed, and narrowly escaped drowning. With great difficulty and suffering intense pain he was taken out of the water by his companions, who carried him in their arms some 200 yards over rocks. Subsequently he was found to be paralysed from the level of the fifth segment, movement being limited to elevation of the arms. Manipulations, followed by laminectomy, failed to give material relief, and he died five years later without recovering any useful function. The only chance for such a patient, according to Cotton, is that a mistake in diagnosis has been made and that an unexpected recovery may follow reduction of the deformity.

Compression Fracture of a Vertebral Body

This is incomparably the most important of all forms of spinal injury for many reasons.

1. It is the commonest form of spinal fracture; about 40 per cent. of all spinal fractures are due to compression, and the majority of these occur in the dorso-lumbar region, and 70 per cent. escape gross nerve injury. Out of a total of thirty-four cases of spinal fracture pure crush of vertebral body occurred in twelve:

D IV	...	...	...	...	...	...	1
D VII	...	...	...	...	...	...	1
D XI	...	...	...	...	...	...	2
D XII	...	...	...	...	...	...	3
L I	...	...	...	...	...	...	5

Fracture-dislocations numbered five:

D XII	...	...	...	...	...	...	3
L I	...	...	...	...	...	...	2

2. The fracture may be complicated, but in a very large number of cases the injury is confined to the compression of a single body without injury to soft tissues and without dislocation.

3. It may be due to very slight violence—for example, a fall down three steps on to the buttocks—or, on the other hand, to gross violence, such as a fall of thirty feet down an elevator shaft (examples from the writer's own cases).

4. It is easily diagnosed by signs of local trauma and distinctive radiological appearances in the lateral x-ray film; it is also easily missed if the patient fails to consult his doctor or if the nature of the injury passes unsuspected. The writer has seen many examples of both these mistakes in examinations of unrecovered patients for insurance companies.

5. Treatment depends on principles easily applied, and the results on the whole are good; failure to apply suitable treatment leads to irreparable deformity, with intractable and disabling symptoms.

CAUSATIVE FACTORS

There are two predisposing causes: the strength of the posterior column of the spine and its posterior convexity; and the compressibility of the spongy bone forming the vertebral bodies and the ease with which flexion occurs when pressure is put upon the spinal extremities.

The exciting cause of compression fracture is almost invariably indirect violence, as already described. In all cases there is acute flexion at the site of the fracture, which is usually the lower dorsal or upper lumbar region. If the fractures of the two lower dorsal and the two upper lumbar vertebrae are added together they will be found to include more than 50 per cent. of all fractures of the spine. Ordinary falls from limited heights are responsible for uncomplicated compression fractures in the dorso-lumbar region. Compression fractures in other regions or complicated compression fractures in the dorso-lumbar region are due to falls from considerable heights, or occur in severe motor and machinery accidents.

MORBID ANATOMY

The mechanism of a crush fracture is similar to that by which a nut is crushed between the jaws of a nut-cracker, the jaws being represented by the vertebrae above and below the one broken. The posterior part of the body is protected by the strength and rigidity of the articular processes, and hence the spinal body after the injury becomes wedge-shaped with the narrow part in front. The extent of wedging depends on the amount of violence. In cases due to slight violence there may be no fragmentation, the anterior common ligament preventing the escape of bony fragments in front. Occasionally this typical deformity of the body is absent, due, for example, to immediate restoration of the bone to its normal outline. In such cases other evidences of fracture must be sought for in the lateral *x*-ray film. These are: a localized increase of density in one part of the body; the presence of lines of fracture; and evidence of convergence of the adjacent surfaces of the vertebrae above and below the one suspected (Kohler). In severe compression fractures there may be an outward spread of loose pieces of bone in front, laterally, or even posteriorly, and frequently this spread is asymmetrical in its distribution.

In some cases of injury in which a compression fracture might be expected from the nature of the accident and from the symptoms, no typical deformity or other evidence of fracture can be found. In one of my cases (not on the hospital list) there was a complete disappearance of the intervertebral disk between the fifth and sixth dorsal bodies. Kohler regards such disappearance, or an extensive irregularity in the structure of the disk, as strong evidence of fracture. These irregularities of the disk due to trauma have also been described by Sashin, and Dandy has found extrusion of the cartilage of the disk into the spinal canal the result of trauma causing pressure on the cord. All such cases should be regarded and treated as fracture. The patients should be advised to wear a suitable support for a prolonged period, otherwise a progressive deformity of the wedge-shape is likely to arise. It is only in cases of posterior displacement of bony fragments, or where dislocation complicates fracture, that injury to the cord occurs, and such a complication arises most frequently in the cervical region.

The diagnosis of compression fracture depends on the history of an accident of the kind already described; signs of local trauma, such as pain, deformity, or rigidity (in complicated cases—for example, with dislocation—there may at first be preternatural mobility and signs

of root or cord lesions); and radiological appearances, which are usually quite typical on the lateral *x*-ray picture of the spine.

TREATMENT OF CRUSH FRACTURE

The method of reduction, as published by Watson Jones in the *British Medical Journal* in February, 1931, has been employed in practically all cases in the Royal Victoria Hospital since that date. Details of the method are not given in this communication. Those especially interested in the subject are referred to the original article. A few details may be mentioned, and these refer mainly to fractures in the dorso-lumbar region: (1) Patients suspected of fracture are *x*-rayed on the way from the out-patient department to the ward, at least two films being taken. (2) No general anaesthetic is given, but the patient, before going to the theatre, is given morphine 1/4 grain hypodermically. (3) The two-table method is used. (4) The patient is clad in stockinette from neck to knees, adhesive felt being placed over the iliac crests, the sacrum, and the site of the fracture. (5) The patient is placed prone with the thighs resting on the lower table and the arms and head upon the higher. (6) As soon as full hyperextension has been obtained plaster-of-Paris is rapidly applied. (7) The plaster is allowed to dry, trimmed off, and the patient is returned to bed.

Watson Jones insists upon early spinal exercises, early assumption of the erect position, and early return to work. An attempt has been made in the Royal Victoria Hospital to follow out this somewhat idealistic programme of after-treatment. As regards first-aid treatment he suggests that patients in whom fracture of the spine is suspected should be immediately placed prone on the stretcher by the ambulance men. This instruction to first-aid men has been called in question by some of Watson Jones's colleagues in Liverpool, notably McMurray, who points out with truth that in some examples of spinal fracture, especially those in the cervical region, respiratory failure forms a real risk to life. To know when this risk must be avoided would require more knowledge than can be expected from the average ambulance man when he is called to deal with a person severely injured and shocked.

Watson Jones's method of retaining plaster on patients completely paralysed—for example, in fractures in the upper part of the spine—has also been criticized. Even in patients unparalysed the prevention of bed sores is attended with some difficulty, and with a patient paralysed it would appear to be almost impossible.

Fractures of the Coccyx

Out of our thirty-four spinal fractures two occurred in the coccyx. This proportion agrees with Cotton's view that fracture of the coccyx is a common accident. Both cases were due to falls on the buttocks and both were in men. (Such cases have to be differentiated, as Cotton points out, from similar injuries occurring in women, where falls on the buttocks not causing fracture are followed by intractable neuralgia. This is a serious condition, and does not appear to yield to any known form of treatment, even excision of the whole coccyx.)

The diagnosis of this type of fracture depends on the history of a fall on the buttocks; signs of local trauma, such as deformity and crepitus, most readily discovered by palpation of the fracture per rectum; and the radiological appearances. In both the cases of fractured coccyx in the present series recovery was complete, in the first after manipulation of the distal fragment into normal position, and in the second after its excision.

Fracture of a Spinous Process

This is due to direct violence. It may occur as a complication of fracture of a body or a neural arch. Diagnosis depends on the recognition of signs of local trauma, irregularity in the line of the spinous processes, and crepitus, without cord or nerve symptoms. Treatment is by immobilization, when sound, fibrous union is to be looked for. Occasionally it may be necessary to remove the loose fragment.

Fractures of Laminae

These may occur with or without depression of the neural arch. They are due to direct violence. The diagnosis depends on signs of local trauma, crepitus, rigidity, and x-ray appearances. In some cases there may be evidence of pressure on the cord. Treatment should be by open operation, especially in the presence of pressure on the cord, which may be due either to blood or to depressed bone. The prognosis after operation is almost universally good.

Fracture of Transverse Process

The common type of fracture of transverse processes belongs to the category of sprains of the back rather than that of spinal fractures. The injury appears to be due to a spasmodic muscular contraction. It is unilateral and multiple, and always occurs in the lumbar region. A fracture of a single transverse process may occur in any region of the spine, and may be due to direct violence. This accident is rare in the lumbar region owing to the depth at which the process lies. Injuries causing fractures of transverse processes in the lumbar region are a fruitful source of litigation under workmen's compensation and following motor accidents. To judge by one's experience in court, the fracture appears to give rise to severe pain, made worse by hyperextension of the hip on the same side or by bending the back towards the opposite side. There is also some rigidity and tenderness on the affected side.

Eight fractures, all in the lumbar region, were found among our thirty-four spinal fractures. This would seem to be an unduly large proportion, but all the cases showed the typical distribution of the fractures—that is, they were multiple and unilateral. They were all treated by immobilization in bed for two or three weeks, followed by massage and exercises. Five cases were reported as having given perfect results, allowing the patients so treated to return to and continue at full work. The duration of incapacity is not noted. These results make the prognosis appear unduly optimistic.

Results of Treatment of Cases under Review

Death occurred in two cases of fracture in the upper cervical region on the day of admission, in one case of fracture-dislocation of the twelfth dorsal vertebra in a few hours, and in one case of fracture of the eleventh dorsal vertebra on the ninth day. In a fifth case—compression fracture of first lumbar vertebra—the patient, after complete recovery, died of cancer of the stomach two and a half years later.

One patient is paralysed three years after a fracture-dislocation of the first lumbar vertebra; five suffer from root pains—only one very severe; nine suffer from some pain, rigidity, and weakness of back generally; and eighteen are either doing, or fit for, full work.

All cases of fracture of a body were treated by the method advocated by Watson Jones. In no case was laminectomy performed.

HARE-LIP*

BY

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In the time limit of twenty minutes allowed for this paper it is obviously impossible to discourse on the paediatric management of the operative, pre-operative, and post-operative treatment of the various types of hare-lip. I shall therefore confine my remarks to the most severe common type—namely, the complete single cleft of the lip with accompanying cleft of the alveolus and palate. Even in this type there are so many variations offering different operative problems that one is forced to the conclusion that no two hare-lips are exactly similar. In general, however, the problem is not so much the union of the lip as the creation of a satisfactory nostril.

Age at Operation

Operation on the lip should be completed before the infant is 4 months old. If this can be satisfactorily accomplished the pressure exercised by the musculature of the re-formed lip will push back the most prominent cleft alveolus within twelve months as a rule. I used to operate during the first few days of life, but of late years I rarely operate under two months unless the baby is growing vigorously. If the nutrition problem is under control and the infant gaining at least four ounces a week, the age of election for operating is from 6 weeks to 3 months. If operation is not possible for various reasons before the child is 6 months old there is grave risk that the projecting alveolus will overlap the opposite maxilla permanently.

Feeding of the Infant with Hare-lip

Special endeavour should be made to maintain the breast milk supply by stimulation and expression, carried out by nurses skilled in these manipulations. Failing the breast milk, cow's milk mixtures prepared according to the caloric needs of the infant are adequate in most cases. Some very difficult and slow feeders are better catered for by the use of lactic acid milk, with or without added carbohydrate, because the greater concentration enables smaller feeds to be taken.

An infant with the type of lip under discussion is often quite unable to suck the breast at all. The rubber vulum designed by Wearne of Sydney not only facilitates sucking from the breast or feeding bottle but materially shortens the feeding time. I do not advise its use for more than a few weeks, as I consider it interferes with the natural tendency to closure both of the lip and of the palate. Other means of feeding these babies varies with the individual infant; some take well from a bottle fitted with a long teat and rather large opening, others do better with a Breck feeder, some like the spoon or pipette feeding best, while many take their feeds well from a funnel and small catheter, given slowly. As pipette, spoon, and catheter methods are preferred after operation these are usually practised at any rate for a few days prior to operation. The pipette, unless well rounded, should be tipped with rubber.

Pre-operative Management

No operation is attempted if the baby has had recent contact with any infectious disease, shows any sores or running nose or ears, or has any cough or tendency to

* Read in opening a discussion in the Section of Diseases of Children at the Annual Meeting of the British Medical Association, Melbourne, 1935.